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ABSTRACT

The New Paltz, New York, school district has used the IBM Vehicle Scheduling Program (VSP) for scheduling its bus runs. In the process the district has reduced its transportation costs by 33.9 percent over a two-year period. (IRT)

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SPEAKER: Frank A. Hamilton, Assistant Superintendent of Schools for Business
New Paltz, NY

TOPIC: Problems and Answers for School Busing

PLACE: Room F, Convention Hall

TIME: 2:30 P. M., Sunday, February 22

PROGRAM: Page 71

Summary of Remarks

I receive inquiries from all over the United States regarding the use of computers to route and schedule school buses. From Maine to California schools are aware of the need to update their methods of determining how the children are picked up for school.

The economics of today's world adds to the urgency attached to school peoples need to automate their procedures.

This afternoon I will talk about one method available to you.

In New Paltz our 1970-71 transportation budget was \$218,535.00. In 1971-1972 the budget decreased to \$185,381.77 or a decrease of 17.8%. In 1972-1973 the budget further decreased to \$163,106.00 or a decrease of 33.9% over a two year period. This was accomplished even though costs of supplies and labor increased dramatically.

I mention this in the beginning because the adversary of the use of computerization of school bus routes have indicated to me that they see no reduction in budgets. As you can see this was not the case in New Paltz.

Now that I hopefully have you convinced that you should try to institute a procedure in your district, I will return to my story of why and how we became a pioneer in this area.

New Paltz is located in the historic Hudson Valley of New York State. We are surrounded by IBM plants which may account for the fact that we have availed ourselves of every opportunity to improve our school's application through the use of computers. We believe that routine tasks are better accomplished and are performed more efficiently by properly programmed computers. We believe that the more data available to you makes your decision making easier. We have in a relatively short time progressed from Unit record equipment to a 370-125.

Through the use of some overhead transparencies and slides I hope to be able to guide you through the process necessary for you to develop and use VSP. If you decide to use an outside company, you will have some idea of what service they will provide you with. I believe that regardless of what system is used the same data must be obtained.

Many schools are found with the problems of racial imbalance and they need to have available to them an immediate way of determining bus routes so as to meet State or Federal mandates. This provides that service -- need I say more.

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At the start of the energy crisis -- and it seems that we are in some sort of crisis -- we had parents concerned about picking their children up in the dark.

At a large public meeting I was asked by the Board if a certain change of scheduled hours would be possible with the number of bus routes available.

I was able to reply that if I could get on the computer in the morning I could have that information available by noon.

Unless you have automation there is no way you can actually make this type of judgment.

I found that IBM did have a working program called VSP, which stands for VEHICLE SCHEDULING PROGRAM. The purpose of VSP or as I call it computerized bus scheduling is to help solve school busing problems.

I enrolled in a workshop being conducted in Syracuse, N. Y. to learn more about this method. I was fortunate to have IBM send along at their expense two system engineers so that they could also become familiar to be in a position to help. It proved to be a most satisfactory class. As a result of this successful experience we proceeded with the initial work as soon as the class was over and we had returned home.

I understand that IBM is currently not offering this service, but I am sure the same information can be obtained from a workshop run by the Ulster BOCES.

In actual practice scheduling of students for classes or scheduling of students for buses differs little in its outcome.

You will always have conflicts in student class scheduling and you have conflicts in bus scheduling which must be resolved manually but which do not create large problems.

What I will try to do this morning is give you an overall view of this application so that you may be aware of how it has worked for New Paltz. I will try to be fair and point out both the good points and the weak points in the system. I will also mention an improved program called VSP-X which I have used and found beneficial to our operation.

Many of the same problems found in commercial routing are also found in school bus routing, which has, as well, unique problems. VSP was originally designed to fill a troublesome gap in the overall cycle of a typical business where the movement of vehicles over prearranged routes was involved. We have found that VSP as applied to school busing indicates that similar improvements may well occur in this area.

Just some statistics about New Paltz.....We transport 2300 students, operate all district owned equipment with 31-60 passenger buses and 6-12 passenger carryalls. Last year we ran 316,000 miles on regular routes. We have one High School, 9-12, a Middle School Gr. 5-8 and one elementary K-4. We also transport to the Campus Learning Center Gr. K-8 and a two room school in Gardiner.

Faced with increased requirements and even faster rising costs, the field of education today has quite literally become everybody's problem.

One particularly difficult part of this problem involves the routing and scheduling of a fleet of buses to or from a school in an efficient manner.

We are all interested in the optimum bus run.....that is we want to use the least number of buses possible within our time limit and seating capacity to do the job. Doing this will keep our costs within budget and state limitations.

For every bus stop there is a certain distance, a certain time and a certain expense to be concerned with.

Each of us, given the necessary time and information could take a map of the school district, mark on the map where the bus stops are, how many students there are at each stop, then draw a line connecting up the stops and come up with a route that would bring the students into school.

I am sure though, that if each of us were to do this now, we would come up with a possibility of a different bus route from each participant in this room, for the same sixty children.

The factors involved in routing are familiar to all of us. Such items are.... can the same bus pick up children at two given stops five miles apart. Is it feasible to place these students on the same route. What are some of the restrictions in our way.

For instance, a bridge with a limited weight capacity may prohibit the use of large buses or in the case of New Paltz a small mountain road may limit the bus size. Today, handicapped children also poses a problem which the computer can accommodate.

Now lets talk about the computer program itself.

It consists of two principal parts:

1. The Network analysis program
2. The Schedule Production Program

I should make it clear at this point that I am not a technician. I make no pretense of understanding the programs internal workings; IBM or BOCES can give you this support when needed.

THE NETWORK

Network analysis determines the distance and traveling time between each pair of potential students points. However, the resulting file is then reduced to contain only those sets of pairs that represent practical combinations of student pickups. The final output is sequenced so that the pair with the largest savings obtainable by placing both deliveries on the same vehicle first. This file is referred to as the Savings File and becomes input to Schedule Production. The Network where you connect up every possible combination of roads by the use of numbers. The computer analyses the network of potential students to be picked up. This is a map of our school district which comprises about 104 square miles. As you can see we have interconnected every possible intersection so that the computer can route a bus along any road it wishes. In other words when you finish your network the computer will have information available which allows it to know how the bus could get from this corner of the district to the extreme other end. The computer properly programmed will do this going over the shortest route possible observing any barriers we may have put in its path such as detours, one way roads, small bridges etc. If it sounds complicated, it's really not.

The first time we had our routes on the computer it was an interesting experience to wait the approximate six minutes necessary for the computer to accomplish its search and then look at the print out showing the bus routes. We ran the same students through the computer that we were then transporting to make sure we were in the ball park.... when we came close we knew we were right and that all had not been in vain.

The network will be the most time consuming part of setting up the system.

It may be done by the true distance method or by the coordinate method. The true-distance method considers actual road distances between points. The coordinate method utilizes coordinates to define each location and the program computes approximate distances. While data gathering for the coordinate method is simpler, greater accuracy is obtained through the use of the true-distance method.

We were fortunate that we already had our district divided into what we call area codes. Every five tenths of a mile was assigned a three digit code. Students living within that area were assigned that area code which is a part of any students record. All we had to do was add two zeros prefixing the area code to meet the requirements of the VSP program.

It took a systems engineer and me 4 and 1/2 working days to complete the network. When we were finished and the computer had checked our work we had left out only one link.

Each link card of your network also contains the distance between the two points together with the speed the bus can travel over that particular road. We found that a map wheel worked very well for us as we used the true distance method. We used drivers who were familiar with the roads to give us the speed that could be traveled.

Just for your information - two terms that I am using are Node - which is an intersection or junction of roads and the link is a section of roads joining two nodes.

The Schedule Production Program uses the output of the Network Analysis Program, together with a list of stops to be made, all the general or local restrictions on stops and a complete description of the fleet. It will produce a route list for vehicle and a summary of the fleet utilization.

What I am saying here is this, you have your network - this is now a deck of IBM cards called link cards, on each card are two sets of numbers linking up one intersection with another -- also included on the card is the distance between these links and the speed the bus can travel. Next you must tell the computer what options you wish to exercise - The Schedule Production program offers many options applicable to schools. Option selection permits the tailoring of bus scheduling to specific local demands. The stop options most applicable to schools are:

- Limited or specific calling time per stop
- Average fixed time for all stops (allowing for deceleration, flashing lights, and other routine actions.)
- Special time for an individual stop
- Vehicle limitations by stop (1 side or special stops)
- Average vehicle speed for the fleet
- Earliest possible starting time, latest possible finishing time
- Maximum route time
- Maximum number of stops per route
- Average unloading time per student

All of the options may be used separately or in combination to realistically describe a unique bus scheduling situation.

All of these options are much a matter of the insertion of one card into the proper place to be feed into the computer.

SO WHAT WE ARE SAYING UP TO THIS POINT IS:

WE TAKE A MAP OF THE SCHOOL DISTRICT, MAKE UP OUR NETWORK OF ROADS, THAT IS INTERCONNECT EACH ROAD INTERSECTION WITH THE NEXT SO THAT THE COMPUTER KNOWS THE ROUTES AVAILABLE.....WE THEN TELL THE COMPUTER THE NUMBER OF BUSES WE HAVE, THE BUS CAPACITY, THE MAXIMUM TIME THE BUSES ARE AVAILABLE AND THE TYPE. WE ALSO INDICATE ANY RESTRICTIONS WE WISH TO USE, THE NUMBER OF STOPS AND WHERE THE STOPS ARE LOCATED..... WE DO THIS BY, IN OUR CASE INSERTING ONE CARD FOR EACH STUDENT--YOU MAY WISH TO SET BUS STOPS AND IF SO YOU WOULD INSERT A CARD FOR EACH STOP INDICATING THE NUMBER OF STUDENTS AT THAT STOP. I PREFER MYSELF, IF POSSIBLE, TO HAVE AN INDIVIDUAL CARD FOR EACH STUDENT. I CAN SEE WHERE IT MAY BE MORE ADVANTAGEOUS TO HAVE A CARD FOR EACH STOP IF YOUR NETWORK CAN ACCOMMODATE THAT.

AFTER ALL THIS INFORMATION IS PUT INTO THE COMPUTER IT TAKES ABOUT SIX MINUTES BEFORE YOU HAVE YOUR ROUTE LISTS AND FLEET UTILIZATION FORMS.

IT SOUNDS FAIRLY EASY--BUT IN ACTUAL PRACTICE IT REQUIRES A GREAT DEAL OF WORK ON THE PART OF THE PERSON RESPONSIBLE FOR ROUTING YOUR SCHOOL BUSES AND YOUR DATA PROCESSING PERSONNEL TO WORK OUT THE NETWORK AND MAKE CERTAIN OTHER INFORMATION AVAILABLE.

HOWEVER, TO DO THE SAME FUNCTION BY A MANUAL METHOD ALSO REQUIRES A GREAT DEAL OF TIME. AS I INDICATED EARLIER, WITH 35 OF YOU ROUTING A BUS MANUALLY WE WOULD PROBABLY COME UP WITH 35 DIFFERENT RUNS. AT LEAST WHEN IT IS DONE ON THE COMPUTER YOU KNOW THAT THIS IS THE MOST EFFICIENT ROUTE POSSIBLE AS FAR AS MILEAGE AND TIME ARE CONCERNED AND THAT THE ROUTES CAN BE USED AS PRESENTED WITHOUT MODIFICATION.

OUR SUPERINTENDENT WAS SKEPTICAL ABOUT USING VSP. HE HAD SOME DOUBTS AS TO HOW MUCH TIME WE WOULD SAVE AFTER WE HAD SPENT SEVERAL HOURS AT THE DATA CENTER WAITING FOR COMPUTER TIME (I ASKED HIM TO GO WITH ME, BECAUSE I KNEW OF HIS APPREHENSION) AND WE HAD OUR FIRST RUN HE TURNED TO ME AND SAID, "YOU KNOW FRANK THIS IS GOING TO WORK" & IT WILL WORK FOR YOU IF YOU DECIDE TO WORK TOGETHER ON IT ... NOT FOR THE PURPOSE OF CHANGE FOR CHANGE SAKE BUT FOR THE SAVINGS OF EQUIPMENT AND PERSONNEL THAT CAN BE AFFECTED.

IN SEPTEMBER 1970, WE ACTUALLY STARTED RUNNING OUR HIGH SCHOOL BUSES ON ROUTES DESIGNED BY THE COMPUTER. WE DID OUR INITIAL WORK IN FEBRUARY SO WE HAD AMPLE TIME TO EVALUATE THE OUTPUT. THE FIRST TO FULLY IMPLEMENT VSP IN NEW YORK STATE. JOE CARUSO AND MORRIS SHAPIRO OF THE DIVISION OF EDUCATIONAL MANAGEMENT SERVICES FIRST TOOK OUR OUTPUT AND EXAMINED IT. THEY THEN CAME DOWN TO NEW PALTZ AND WE TOOK THEM AROUND ON SOME ROUTES SO THAT THEY COULD ACTUALLY SAY THEY HAD SEEN VSP IN ACTION, THAT THEY HAD ACTUALLY RIDDEN A BUS OVER A ROUTE DESIGNED BY A COMPUTER. THE STATE EDUCATION DEPARTMENT'S POSITION ON THE USE OF COMPUTER TRANSPORTATION SCHEDULING HAS BEEN DISAPPOINTING UP TO THIS TIME. I HAVE ASSURANCE THOUGH FROM JOE CARUSO, THAT THEY WILL IN THE FUTURE, SUPPORT THE IMPLEMENTATION AND EXPERIMENTATION OF VSP.

VSP OR COMPUTERIZED TRANSPORTATION SCHEDULING IS NOT ONLY A DYNAMIC TOOL AIMED AT REPETITIVELY SOLVING THE CRITICAL PROBLEM OF BUS SCHEDULING, IT IS ALSO A PLANNING TOOL FOR THE QUESTIONS IN EDUCATION TRANSPORTATION.

What if a large new subdivision is built? What if we changed our hours for a school? What is the probable effect of a proposed New School Site?

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Shortly after we made our initial run, the Board of Education at a Monday night meeting indicated to me that they would like to know what the bus requirements would be for four different possible elementary school sites. They further indicated that they needed this information by the following Monday night for a public meeting. I could have made a good guess based upon certain information available and the Board could have gone to the public meeting and said that Frank Hamilton had worked this out and in his estimate we will need a certain number of buses for each school site. The public would very well have thought that the results were slanted for the site we wanted. Instead, the Board was able to go to the public meeting and indicate that based upon the student population assigned to that area school, worked out by computer we will need X number of buses at each school site This information was well received by the public. I am sure that all of you have this same type of information to provide.

Another example would be, two years ago our teachers association was hard at work at changing school hours I was on their committee and with the help of BOCES here in New Paltz we were able to produce routes which showed that to do what they wanted would have cost an additional five buses or \$50,000. in our budget. Needless to say, the hours did not change in this manner If I had worked this out myself I am sure the end result would not have been accepted as valid fact. Another advantage is that bus purchase requirements can be known months in advance. We may not wish to route the school buses in November for the following September but we do need to know for budget purposes how many additional buses we will need for the following school year.

This method of routing and scheduling opens up new concepts of scheduling ... by that I mean that anyone who has been scheduling buses over the same routes for a period of time gets used to doing it a certain way. The computer does not have this human trait and when you look over the routes at least I said to myself Why didn't I think of doing it that way.

Now what are the disadvantages because certainly there are and I am not about to tell you there are not:

1. Schools with good manual scheduling systems may be reluctant to become involved in the extra work.
2. It would be nice to have the print out more clear as to the road it means for you to travel Some human determination must be made.
3. The computer does not produce a map, only a route schedule This takes time to convert into a route on a map. However, I must say that in two hours I am able to do 40 routes.
4. By products such as bus cards, time at individual stops and better directions need to be developed.

HOW SHOULD A DISTRICT PROCEED TO IMPLEMENT AN AUTOMATED SYSTEM

1. There should be general agreement among the Board of Education, Superintendent, and transportation personnel that they are willing to experiment.

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2. Proper budget allocations need to be made Out total cost on the initial run was about \$1300.00 this was about \$750. for a systems engineer and \$350. for computer time.
3. Obtain a set of maps of your school district.
4. Have your transportation supervisor and the person most knowledgeable about data processing in your district attend meetings and workshops. I would suggest that the implementation of this process requires a team effort so involve everyone who might be connected. In my case it was easy I have both data processing and transportation responsibilities.....

So to sum up

For the taxpayers - VSP can provide cost savings such as I have mentioned previously where we have reduced our costs by 33.9%

For the School administrator - can provide you in five to 10 minutes with most of the data that would otherwise take days to work out.

For the school boards and policy makers - it provides accurate data for building the budget process as relates to new buses and construction of new facilities

Every school district can achieve a new dimension of economy It is a dynamic tool aimed at solving the immediate problem of bus scheduling.

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